Author(s): Mero, Joel; Karjaluoto, Heikki; Tammisalo, Tanja

Title: How a glass-processing SME developed its big data competence

Year: 2021

Version: Accepted version (Final draft)

Please cite the original version:

Mero, J., Karjaluoto, H., & Tammisalo, T. (2021). How a glass-processing SME developed its big data competence. In C. Lund Pedersen, A. Lindgreen, T. Ritter, & T. Ringberg (Eds.), Big Data in Small Business : Data-Driven Growth in Small and Medium-Sized Enterprises (pp. 117-127). Edward Elgar. https://doi.org/10.4337/9781839100161.00015

How a Glass-processing SME Developed Its Big Data Competence

Authors: Joel Mero, Heikki Karjaluoto & Tanja Tammisalo

This is a draft chapter. The final version is available in Big Data in Small Business: Data-driven Growth in Small and Medium-sized Enterprises edited by Carsten Lund Petersen, Adam Lindgreen, Thomas Ritter, and Torsten Ringberg, published in 2021, Edward Elgar Publishing Ltd https://doi.org/10.4337/9781839100161

1. Introduction

The extant literature offers extensive discussions of the resources and capabilities that are needed to make big data valuable for businesses (see, e.g., Barton & Court, 2012; McAfee & Brynjolfsson, 2012; Mikalef et al., 2019). While big companies may be able to advance big data initiatives by simply acquiring the necessary human skills, know-how, and technical infrastructure, SMEs with limited funds and limited technical expertise need to take more innovative routes to build big data competence.

Although the proficient use of data is associated with business performance in SMEs (Ferraris et al., 2019; O'Connor & Kelly, 2017), the literature does not provide actionable insights into the capabilities that foster the development of big data competence over time. To fill this void, this study describes how Glaston, a glass-processing SME, has overcome the constraints many SMEs face in their big data journeys. While describing Glaston's journey, the study focuses on the dynamic capabilities (i.e., market listening and business imagination, open innovation, and a culture of experimentation) that have stimulated Glaston's development of its big data competence. We elaborate on the impact of these capabilities using an illustrative example—the creation of the Glaston Siru, a mobile application that uses unstructured image data.

2. Theoretical background

In order for businesses to make big data valuable, they must have a versatile set of capabilities. Brinch et al. (2020) identify 24 types of big data capabilities related to IT, process, performance, human, strategic, and organizational practices. However, the extant research on big data in business has primarily focused on *analytics* capabilities that provide firms with the technical competence needed to refine data into insights (Sivarajah et al., 2017; Wang & Hajli, 2017). Although analytics know-how is a clear antecedent for big data usage, it does not guarantee that a firm can turn big data into a competitive advantage and business value. Accordingly, Mikalef et al. (2020) show that the relationship between big data analytics capabilities and a firm's competitive performance is mediated by the firm's dynamic capabilities. In other words, the business value of big data analytics capabilities is determined by the firm's ability to develop organizational routines that advance data-driven business renewal.

"Dynamic capabilities" refer to the capacity of the firm to sense opportunities and threats, seize opportunities, and transform organizational routines by reconfiguring organizational resources and assets (Teece, 2007). A number of studies have demonstrated the important role of dynamic capabilities in leveraging big data to improve business performance (Erevelles et al., 2016; Gupta et al., 2020; Shams & Solima, 2019). Our theoretical approach builds on the notion that dynamic capabilities are needed to make the most out of big data initiatives. In particular, we propose that dynamic capabilities play a critical role in big data usage, especially in terms of ensuring that the firm focuses on relevant business opportunities that can be seized via advanced use of big data. However, although the extant research has demonstrated the impact of big data analytics capabilities and dynamic capabilities on business performance, it fails to provide in-depth insights into the specific dynamic capabilities that nurture the development of big data competence over time. We address this shortcoming by presenting an in-depth description of Glaston's dynamic capabilities, which not only have stimulated its big data competence but also resulted in a number of practical applications that have brought value to Glaston and its customers.

3. Description of the case company: Glaston

Glaston is a glass-processing technology company headquartered in Finland and listed on the Nasdaq Helsinki Oy exchange. In 2020, the company had about 800 employees and annual revenue of about EUR 200 million. Glaston roughly doubled its size in 2019 via the acquisition of Swiss-German Bystronic glass. Notably, the big data journey described in this chapter is primarily focused on the time before the acquisition when the company was half of its current size.

Glaston's history dates back to the nineteenth century paper-mill industry, but its glass-processing technology business emerged in 1970. In 2007, the company changed its name from Kyro to Glaston. Today, Glaston has four factories on two continents (Europe and Asia) and customers around the world. Glaston produces glass-processing machinery and technologies that serve the needs of glass manufacturers in the architectural, automotive, solar, and appliance industries.

The company's strategy is to seek growth by offering high-quality glass-processing machinery that is augmented by digital services. It differentiates itself from its competitors through its status as the industry's innovative technology leader, and it works to help its customers efficiently realize their ambitions in glass processing. A technological orientation has been at the core of Glaston's strategy throughout its existence. It has closely followed advances in technology and continuously tried to capitalize on those developments. For decades, Glaston has adopted the latest technologies, thereby ensuring that its customers have been able to enjoy the benefits of, for instance, increased automation and a reduced need for human resources in glass processing. Glaston was also an early adopter of enterprise resource planning (ERP) customer relationship management (CRM) systems, and it has been able to integrate customer relationship, sales, and logistics data into a unified cloud database, which provides it with better visibility for its marketing, sales, and product-delivery processes. However, the most recent leaps in the use of data and technologies have occurred in relation to the Internet-of-Things (IoT) and the big data that Glaston's machinery produces on the customer's end. The remainder of this paper focuses on these developments.

4. Glaston's big data journey

Glaston's big data journey began in the mid-2010s when the company recognized the potential value of collecting big data from their machinery. The company realized that by connecting its machinery to a cloud service, it could remotely access data on how customers used its machinery. Although Glaston was not sure how it could transform that data into business value, it started to implement IoT and cloud-service solutions as soon as it signed agreements with customers. In the early phase, data were collected on, for instance, the types, sizes, and thicknesses of processed glass; the extent to which machines were used efficiently; and how and when the machines were maintained.

As the data accumulated, Glaston began to evaluate what it could do with that data and what other data points should be added to derive meaningful insights that would improve the customer experience. Careful consideration led Glaston to envision a fully automated processing line that could produce standardized, high-quality glass that meet specific customer needs as efficiently as possible with minimal human intervention. The rationale behind this vision was that the quality and efficiency of glass processing is highly dependent on the skills of the individual processing the glass. Thus, the introduction of highly automated, standardized processes would allow almost anyone to produce high-quality glass products, leading to significant benefits for customers. The vision was ambitious, but Glaston was convinced that this was the right direction and started to take steps to reach its goal.

An important step on the journey was the launch of the *MyGlaston Portal*. The portal was a digital interface offering customers access to product-related information that could help them maximize the efficiency of production with Glaston's machinery. In addition to relevant information regarding product features and user manuals, the portal included real-time data on the operation of the machines owned by the customer (e.g., how many loads per hour, the amount of glass in each load, and the glass types and products that were processed). The second significant step was the introduction of *iLook* data to the portal. iLook is an industrial measurement tool that provides data on the quality of glass processing by detecting whether the production of different glass products meet the customer's quality standards (i.e., measurement thresholds). For example, it can recognize quality defects, such as waviness on the surface of the glass.

Recently, Glaston had begun to develop and pilot a new feature entitled *Machine Health.* This function was expected to build on the iLook feature and holistically examine the various functionalities of the machinery that affect product quality. Thus, while iLook detected quality errors, Machine Health was being designed to provide data that is useful for analyzing the causes of quality errors. Consequently, it would allow Glaston and its customers to predict needs for maintenance and spare parts.

The MyGlaston Portal provided customers with visibility into their production processes. Equipped with this information, they could optimize the energy efficiency and quality of the production process. More specifically, by monitoring the differences between machine usage and the quality of output at various times, customers could identify which operators produced the best efficiency and quality. In turn, this knowledge could be shared with others via training programs and the creation of optimal glass-processing recipes for specific glass types. Increased energy efficiency offered a direct monetary benefit for the customers because energy consumption represents a sizeable share of costs in the glass-processing industry. Moreover, quality is important for end users and it is another a significant cost factor, as the glass products need to meet specific quality standards. The higher the proportion of products that meet quality standards, the better the productivity.

Glaston has benefitted from its big data development projects in multiple ways. First, the projects have enabled the company to derive insights into how their machinery is used by customers and to harness those insights in product development by, for instance, adding, removing, or modifying features. Second, Glaston can remotely detect malfunctions, respond to customer queries quickly (even proactively), and provide maintenance guidance. Finally, it can predict customers' needs for spare parts and repair services, leading to higher cost-efficiency and significantly shorter maintenance breaks, both of which are costly for customers.

By the end of 2020, Glaston had connected more than 150 machines located around the world to its cloud. In addition, it had gathered data on about three million glass-processing loads, each of which involved hundreds or even thousands of data points. As manually analyzing such data would be practically impossible, Glaston began implementing artificial intelligence (AI) solutions (e.g., machine learning and neural network algorithms) to create automated and intelligent processing lines that would serve customer needs. Glaston perceived the smart use of big data as its key competitive advantage, and it wanted to stay ahead of the competition by continuously developing its processing lines. In 2019, Glaston piloted an AI assistant that notified machinery operators of quality errors and potential reasons for those errors (e.g., "Did you notice that…?").

The next step is to move from assistance to giving recommendations (or even commands) on how the operator should change the processing recipe (e.g., "I recommend that you make the following changes to the recipe."). If successful, Glaston will be close to realizing its vision of a fully automated, standardized process in which the machine will be allowed to make changes to processing recipes and then notify the operator of the changes made (e.g., "Please note that the recipe has been changed as follows."). A summary of key developments in Glaston's big data journey is provided in Table 1.

Table 1. Timeline of key developments in Glaston's big data journey

Timeline	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Big data application	IoT and cloud services	MyGlaston Portal	iLook online feature	Glaston Siru	AI assistant	Machine health
Description	Machines connected to cloud database	Digital interface to access product-related information	Tool for detecting quality defects	Mobile application for performing tempered glass-fragmentation test	Guidance for machinery users	Detection of machinery malfunctions
Benefits for customers		Optimization of energy efficiency	Improved quality of production	Time and cost savings	Optimization of machinery usage	Shorter maintenance breaks
Benefits for Glaston		Product-development insights via data on customers' use of the machinery	Remote detection of quality defects and faster responses to customer queries	Improved brand image	Step towards fully automated, standardized processing lines	Prediction of maintenance and spare-parts orders

5. Dynamic capabilities for turning big data into business applications

For Glaston, the fundamental driver of successful big data usage has been a genuine desire to create the best possible product—a product that exceeds customers' expectations and differentiates Glaston from its competitors. However, there is a significant gap between this abstract desire and its fulfillment. Glaston's core strength in terms of fulfilling that desire stems from three co-existing dynamic capabilities that support each other (Figure 1). The first, *market listening and business imagination* focuses on sensing technological opportunities and adapting them to Glaston's business context. The second, *open innovation*, refers to Glaston's collaboration and knowledge sharing with external partners, which produces new ideas and implementation insights related to big data initiatives. The third, the *culture of experimentation*, refers to Glaston's tendency to test and validate big data applications before their full-scale implementation. These three capabilities explain the development of Glaston's big data competence primarily because they foster continuous organizational learning. In the following, we describe the roles of these capabilities in Glaston's product-development processes.

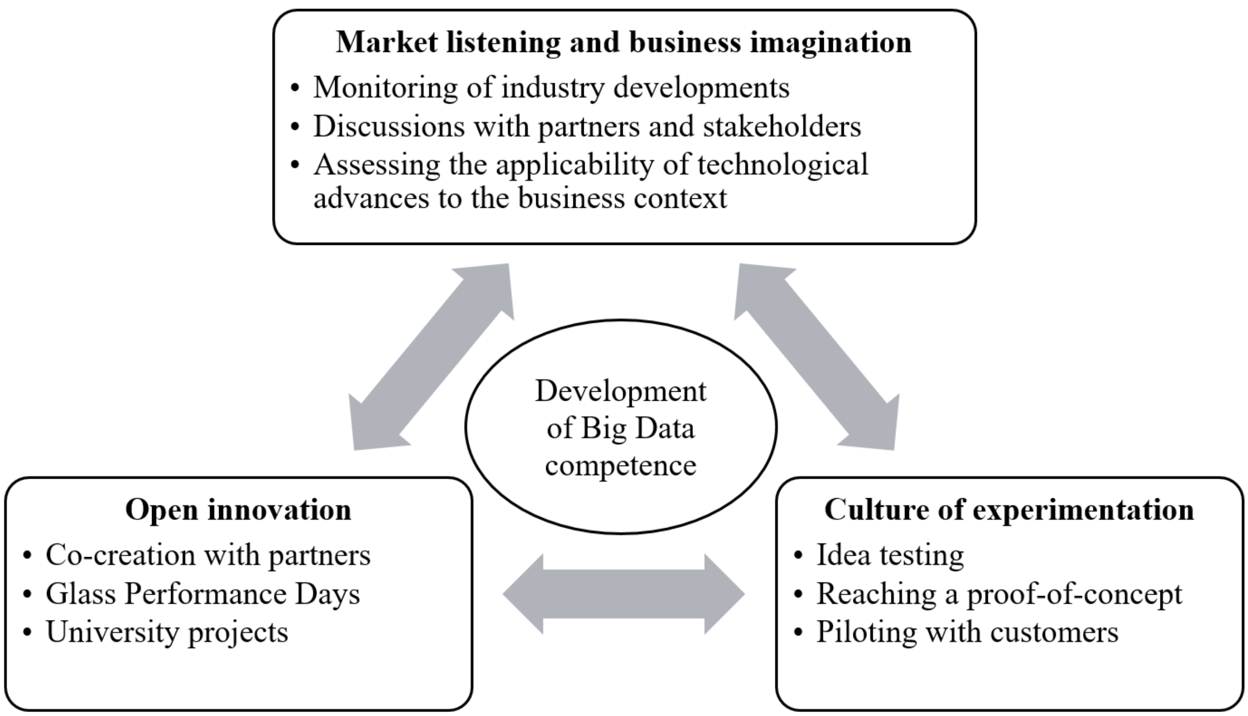

Figure 1. Glaston's key capabilities in leveraging big data for product development

5.1 Market listening and business imagination

As Glaston's business strategy implies, the company believes that the leaders in the glass-processing industry will be those capable of identifying relevant technological advances and applying them in ways that create value for customers. In many companies, such a vision might be shared by members of top management, but it may be difficult to implement and communicate to employees. At Glaston, however, the technology strategy is primarily driven by engineers and designers, who are self-motivated to devote time and energy to monitoring technological developments and to identifying market trends and emerging signals of new opportunities. In addition to monitoring broader industry developments, they continuously listen to partners and stakeholders, and follow the emergence of new startups with fresh ideas.

For an SME, it is important to recognize that the resources it has available may not allow it to create big data solutions from scratch. By keeping an eye on the solutions that the large, Silicon Valley technology companies produce, Glaston can reap the benefits of new solutions by adapting them to its business. An important part of this work involves business imagination, which revolves around analyzing which developments can be adapted to support Glaston's product development and how such steps could be accomplished. Business imagination is further fostered by matching technological expertise with product expertise:

> Often, we just meet with processing-line designers, explain how neural networks work, and ask for ideas for use cases. Then we collect and model the data produced by processing lines, and we discuss the findings with the designers. Through active discussions, we continually generate new ideas and patent applications.[1]

5.2 Open innovation

The second key capability is open innovation. This is particularly important for an SME that has limited resources and skills for internal development. From the beginning, Glaston's big data strategy has been based on extensive collaboration with suppliers, partners, universities, and other companies. One platform for such collaboration is Glass Performance Days (GPD). GPD is a conference organized by Glaston every two years that brings together actors involved in the glass industry around the world. During the conferences, industry experts and practitioners present recent developments in the industry and discuss challenges that they are facing. GPD is a central part of Glaston's identity – a firm that is willing to share ideas and solve problems with other companies.

Glaston has also incorporated formal partnerships into its big data projects. These partnerships have allowed Glaston to shift its focus from technical issues (e.g., maintenance of big data infrastructure) to ways of creating more value for customers through big data. The company's collaboration with universities has been a major factor in the success of its big data projects. The university projects have provided access to expertise and a peer network encompassing a broad range of companies from other industries that have had similar ambitions. Joint learning and knowledge sharing have been extremely fruitful in terms of gaining insights into the types of big data solutions that other companies are developing, and which ones might be beneficial for Glaston. Collaboration has also made Glaston more confident that it is moving in the right direction with its big data development. Furthermore, university projects have provided Glaston with new expertise in the form of commissioned thesis projects. Many of Glaston's successful big data projects have been designed by university thesis writers who familiarized themselves with Glaston's big data challenges and developed actionable solutions. In fact, Glaston has hired several of these writers after completion of their theses, which has increased the company's skills and

[1] All citations are taken from a two-hour interview with Glaston's digitalization manager, Kai Knuutila. The case description is based on this interview and a range of material from company archives.

competence in such fields as coding and neural networks. These new talents have been crucial in designing and implementing new big data projects:

> If you handle big data projects internally, you are on your own and in your own little silo. Therefore, I think that collaborative projects with universities and other companies are extremely important. They connect firms from different industries and, as we are not competitors, we can openly share everything we do and together consider what we could do better. It is a kind of peer-to-peer mentoring, and it is important because you get the feeling that you are doing the right thing.
>
> Thesis projects have been also very productive. On the one hand, we provide young talents with challenging tasks. On the other hand, they have surprisingly strong coding and neural network skills. Often, what we consider challenging has been relatively easy for these students, as they undertake similar tasks during their studies. The projects give us plenty of new knowledge thanks to these young talents.

5.3 Culture of experimentation

The third important capability is the culture of experimentation. Business imagination does not help a firm unless the firm has the courage to test ideas. Glaston wants to be a frontrunner in its industry, and to experiment with all new technologies that might create valuable data or otherwise be relevant for its business. Careful testing in big data projects is particularly important in terms of enabling companies to identify the relevant data points and ensuring that the data is of high quality. Only then is it possible to use machine learning and neural networks for the selected use cases.

Status as a frontrunner means that failures are inevitable, but those failures must be transformed into learning. Nevertheless, Glaston tries to avoid failures that would affect the customer experience. Therefore, a typical experiment goes through several phases. First, an idea is tested using simulators to evaluate its validity until a theoretical proof of concept is reached. Second, the idea is tested and optimized in internal showrooms until an empirical proof of concept is reached. Third, the proof of concept is piloted with a "*friendly user*" customer. Thus, before launching a new feature or service for customers, Glaston requires strong proof that the new feature actually works as intended. The need for a proof is also a part of the organizational culture:

> If we just go to our service-maintenance employees and present them with cool, new features for machinery, they would tell us that we need to prove that they work before they can be implemented. Seeing is believing, and that is what we have to do.

6. The Glaston Siru—a big data application

To illustrate the impact of Glaston's dynamic capabilities, we discuss how Glaston leveraged them in developing the Glaston Siru. The Glaston Siru is a mobile application based on big data that uses image recognition to perform tempered glass-fragmentation tests. The test is used to ensure that the glass fragmentation meets regulations and quality standards. In other words, when glass breaks, it must fragment into small pieces for safety reasons. Traditionally, fragmentation tests have been conducted either by manually counting the pieces of glass or by using massive industrial scanners that cost tens of thousands of euros and are very slow. In contrast, with the Glaston Siru, a user can take a picture of a fragmented glass and the app automatically conducts the test using neural networks. The app can be downloaded for free, and the goal is to give users a taste of Glaston's big data and AI competences.

The project that developed Glaston Siru illustrates the capabilities that enabled Glaston to progress on its big data journey. The preliminary idea for Glaston Siru emerged in late 2017 at a Glaston Hackathon event that was organized together with Business Tampere (an organization offering support for local businesses). Glaston invited startups, engineering students, and university researchers to come up with a new product-development idea for glass processing with a prize of EUR 10,000 for the winner. The open invitation attracted 24 teams (72 participants in total). The hackathon included a presentation on glass processing given by Glaston in its showroom and a discussion of some of the challenges that Glaston wanted to overcome through digitalization and big data. In response, the teams presented ideas and solutions for the challenges. The winning team was made up of researchers from the local university (Tampere University), who came up with the idea for the Glaston Siru.

The hackathon resulted in a research project led by Tampere University that allowed Glaston to access a broader network of companies that were dealing with big data challenges. Moreover, Glaston commissioned a thesis on transforming the idea for mobile app into reality. After completing theoretical research related to the use case, the thesis writer used one summer for the empirical research, which included breaking glass, taking pictures of fragmented glass, drawing the fragmentation patterns, and training neural networks to detect those patterns. The thesis provided a strong theoretical proof of concept. When the thesis was finished, Glaston hired the thesis writer. The task given to this employee was to move from the theoretical proof of concept to its practical implementation. It took only a couple of weeks for the employee to present the first version of the Glaston Siru. At that point, Glaston involved an external partner to design a functioning and aesthetically appealing user interface, which was a fast and straightforward process. Soon thereafter, the application was ready to be launched.

The entire development process took approximately one year and the results exceeded expectations. By late 2020, the app had been downloaded thousands of times and it was actively used by hundreds of people around the globe. As such, interest in the app was significant, especially given that the target group was composed of those responsible for glass-fragmentation tests. As a direct benefit, Glaston was able to use the app to showcase its big data and AI competences, and to build an image of itself as a technological frontrunner in the industry. The Glaston Siru was also selected as a finalist in the *Best Mobile Service* category of the *Grand One 2020* competition, which presents awards to the best work related to digital media in Finland. This was a notable achievement for an industrial SME, as the other finalists had developed apps targeting consumers.

> When customers see that we are able to use functional neural networks in a mobile app, they believe that we can do the same thing with our machinery at scale. The Siru app showcases our competence and increases customers' interest in our products.

The app's indirect benefits were even greater. Prior to the Siru app project, Glaston knew very little about neural networks. The project opened the company's eyes to how it might be able to use knowledge of neural networks in the development of its machinery. Moreover, the company realized how straightforward and easy it was to conduct big data and AI projects after suitable use cases were uncovered. This realization remarkably increased Glaston's confidence and its desire to engage in other development projects. Moreover, the costs of developing the app were low thanks to the company's approach to open-innovation learning and its collaboration with the university. Glaston learned that it could derive remarkable business benefits despite its limited resources if it generated new ideas, had the courage to experiment with them, and was willing to collaborate with other parties.

> The Siru app is a great story because we knew very little about neural networks before the project. We learned that they are surprisingly easy to use if you simply find a suitable use case or problem that they can solve. Many firms feel that AI solutions are difficult. We did not know how difficult it would be, but we had to start somewhere. As we were lucky to find a good thesis writer who did most of the work, the app cost us next to nothing to develop.

7. Future development

Glaston has long been committed to developing its big data competence and it has persistently moved towards its vision of creating automated and standardized glass-processing lines. The company has learned that big data projects are relatively straightforward to complete given an open, curious, and experiment-driven organizational culture. Glaston is devoted to continuing along its chosen path and to leading the way in the glass-processing industry. However, as its big data usage has become more advanced, it is now facing a new set of challenges that it must overcome.

Glaston has adopted a highly customer-centric approach in its big data development, as it has focused on designing big data services that create value for customers. It is reaching a point at which it must carefully consider how all of those value-adding services can be transformed into a new business model. Glaston currently produces most of its revenue by selling machinery and maintenance services. Although some of the features of the MyGlaston Portal are premium features that produce revenue, the company is assessing new revenue models that would create a more constant stream of revenue. One alternative is a subscription model through which the company could generate recurring revenue via software licenses on a monthly or yearly basis:

> It is a matter of how well we can bundle these new services into packages that our customers would be willing to pay for.

The challenges of changing a business model are not limited to bundling new services into offerings for customers. Such changes require a significant organizational transformation. Moving from a focus on hardware to a focus on software is a significant challenge for a company that has focused on selling machinery for decades:

> We have a lot of people who have extensive experience in the industry. They are used to thinking that we are a hardware company that sells machinery. Now we are trying to change our identity from a hardware company to a software company. It is difficult for people to

change their perspective, even though none of our existing machines have worked without software for a long time.

8. Conclusions and managerial implications

This chapter highlights how a manufacturing SME has harnessed big data for product development. The study identifies three dynamic capabilities that Glaston has used to turn big data into value-added services for its customers: market listening and business imagination, open innovation, and a culture of experimentation. These capabilities are closely aligned with the concept of adaptive marketing capabilities (i.e., vigilant market learning, adaptive market experimentation, and open marketing), which enables companies to leverage environmental changes in order to create customer-oriented competitive advantages in a data-rich environment (Day, 2011). Previous research has highlighted the importance of big data analytics capabilities (Ferraris et al., 2019; Yasmin et al., 2020) and the importance of dynamic capabilities (Cao et al., 2019; Gupta et al., 2020; Mikalef et al., 2020) for harnessing big data. This study contributes to this stream of literature by showing how an SME can harness dynamic capabilities for developing a big data competence over time. As such, the study has relevant managerial implications, especially for SMEs that are in the early phases of their big data journeys.

First, market listening and business imagination can serve as the cornerstones of big data competence development. We recommend that managers devote time and effort to actively monitoring technological developments across industries in order to identify big data applications that could have value. Furthermore, managers should encourage cross-functional knowledge sharing related to potential applications as well as imaginative thinking regarding how applications could be adapted to a given business setting.

Second, few SMEs possess the human resources and knowledge needed to design and implement big data initiatives. Therefore, we recommend that SMEs foster open innovation with external partners in order to share best practices and gain collective wisdom for designing and implementing big data initiatives. As Glaston’s case demonstrates, the peer networks of other companies that are developing big data applications can be a source of significant competitive advantage. In particular, university projects that bring together companies with similar interests can be great opportunities to advance big data initiatives and acquire the talents needed to implement them.

Finally, idea generation must be complemented with continuous experimentation in order to test and validate the actionability and business value of those ideas. Managers should foster a culture of experimentation by empowering employees to run tests and offer clear criteria that must be met before implementation. Many projects will fail, but managers should treat failures as learning opportunities instead of blaming employees for disappointing results.

To synthesize the managerial implications, Table 2 presents the key questions that managers should ask when developing the dynamic capabilities identified in this study. We hope that by answering these questions, managers will uncover potential pitfalls in their current practices and be better able to advance their big data competence.

Table 2: Fostering the development of big data competence—key questions for managers

Dynamic capability	Question 1	Question 2	Question 3
Market listening and business imagination	How do we sense new opportunities created by data-rich environments and new technologies?	How do we share the identified opportunities across the organization?	What do we need to do to capitalize on the identified data opportunities? What adaptations are needed in our business context?
Open innovation	How do we currently collaborate with external partners to develop big data initiatives?	Who could help us advance our big data journey? (Companies with similar interests? Universities? Experts? Others?)	How do we convince external partners to collaborate with us? What do we offer them in return?
Culture of experimentation	How does our organizational culture encourage people to test big data applications?	What criteria need to be fulfilled before an experiment proceeds to implementation?	How do we react if an implementation fails even though the experimentation criteria have been fulfilled?

References

Barton, D., & Court, D. (2012). Making advanced analytics work for you: A practical guide to capitalizing on big data. *Harvard Business Review*, *90*(October), 78–83.

Brinch, M., Gunasekaran, A., & Wamba, S. (2020). Firm-level capabilities towards big data value creation. *Journal of Business Research*, 131, 539-548.

Cao, G., Duan, Y., & El Banna, A. (2019). A dynamic capability view of marketing analytics: Evidence from UK firms. *Industrial Marketing Management*, *76*, 72–83.

Day, G. S. (2011). Closing the marketing capabilities gap. *Journal of Marketing*, *75*(July), 183–195.

Erevelles, S., Fukawa, N., & Swayne, L. (2016). Big Data consumer analytics and the transformation of marketing. *Journal of Business Research*, *69*(2), 897–904.

Ferraris, A., Mazzoleni, A., Devalle, A., & Couturier, J. (2019). Big data analytics capabilities and knowledge management: Impact on firm performance. *Management Decision*, *57*(8), 1923–36.

Gupta, S., Drave, V.A., Dwivedi, Y.K., Baabdullah, A.M., & Ismagilova, E. (2020). Achieving superior organizational performance via big data predictive analytics: A dynamic capability view. *Industrial Marketing Management*, 90, 581-592.

McAfee, A., & Brynjolfsson, E. (2012). Big data: The management revolution. *Harvard Business Review, 90*(October), 61–8.

Mikalef, P., Boura, M., Lekakos, G., & Krogstie, J. (2019). Big Data analytics capabilities and innovation: The mediating role of dynamic capabilities and moderating effect of the environment. *British Journal of Management*, *30*, 272–98.

Mikalef, P., Krogstie, J., Pappas, I.O., & Pavlou, P. (2020). Exploring the relationship between big data analytics capability and competitive performance: The mediating roles of dynamic and operational capabilities. *Information and Management*, *57*, 1–15.

O'Connor, C., & Kelly, S. (2017). Facilitating knowledge management through filtered big data: SME competitiveness in an agri-food sector. *Journal of Knowledge Management*, *21*(1), 156–79.

Shams, S.M.R., & Solima, L. (2019). Big data management: Implications of dynamic capabilities and data incubator. *Management Decision*, *57*(8), 2113–23.

Sivarajah, U., Kamal, M.M., Irani, Z., & Weerakkody, V. (2017). Critical analysis of Big Data challenges and analytical methods. *Journal of Business Research*, *70*, 263–86.

Teece, D.J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, *28*(13), 1319–50.

Wang, Y., & Hajli, N. (2017). Exploring the path to big data analytics success in healthcare. *Journal of Business Research*, *70*, 287–99.

Yasmin, M., Tatoglu, E., Kilic, H.S., Zaim, S., & Delen, D. (2020). Big data analytics capabilities and firm performance: An integrated MCDM approach. *Journal of Business Research*, *114*, 1–15.